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**Introduction**

The two countries, Audi Arabia and Irap, are two oil producing countries. Both of these countries are attempting to maximize their profits. In order to maximize their profit, they have to set each of their production levels. Both Audi Arabia and Irap can operate with either high or low production levels. Thinking about supply and demand, the total production levels of both of the countries strategies will determine the price in which the oil sells. The total production is considered as the supply and the price in which the oil sells is the demand. For instance, an individual country prefers the profit of when they sell a higher volume of oil for a higher cost. However, when the supply of the available oil increases, then the sale price will fall. In this paper, we will be analyzing two oil producing countries and we will give them advice on which production levels should be based on a set of assumed conditions.

**Representation**

Productions that result from employing the indicated strategies

|  |  |  |
| --- | --- | --- |
| IrapAudi Arabia | High | Low |
| High | (15,5) | (15,3) |
| Low | (9, 5) | (9,3) |

Total Production

|  |  |  |
| --- | --- | --- |
|             IrapAudi Arabia | High | Low |
| High | 20 million per dayDictates Price: $50 per barrel | 18 million per dayDictates Price: $60 per barrel |
| Low | 14 million per dayDictates Price: $70 per barrel | 12 million per dayDictates Price: $80 per barrel |

The two players in this game are Audi Arabia and Irap. Both Audi Arabia and Irap can employ their strategies of high production levels or low production levels. If Audi Arabia decides to set their production levels high, then they will produce 15 million barrels per day. If they decide to set their production levels low, then they will produce 9 million barrels of oil per day. Also, if Iraq chooses to set their production levels high, then they will produce 5 million barrels per day. If they choose to set their production levels low, then they will produce 3 million barrels per day. Audi Arabia’s cost of production is $10, while Irap’s cost of production is $15.

If Audi Arabia chooses to set their production levels high and Irap chooses to set their production levels high, then their total production output would be 20 million barrels of oil per day. The assumption made on their resulting price of oil is $50 per barrel. If Audi Arabia chooses to set their production levels high and Irap chooses to set their production levels low, then their total production output would be 18 million barrels of oil per day. The assumption made on their resulting price of oil is $60 per barrel. If Audi Arabia chooses to set their production levels low and Irap chooses to set their production levels high, then their total production output would be 14 million per day. The assumption made on their resulting price of oil is $70 per barrel. Lastly, if Audi Arabia chooses to set their production levels low and Irap chooses to set their production levels low, then their total production output would be 12 million per day. The assumption made on their resulting price of oil is $80 per barrel.

 Payoffs

|  |  |  |
| --- | --- | --- |
|            IrapAudi Arabia | High | Low |
| High | (600, 175) | (750, 135) |
| Low | (540, 275) | (630, 195) |

To find Audi Arabia’s and Irap’s payoffs, algebra is required. In order to calculate the payoffs for both countries, you can use the following equation. The number of barrels multiplied by the price of the barrel subtracted by the cost of production. A simplified version of that equation is, the number of barrels multiplied by the profit of barrels. The payoffs associated with the outcome (high, high) is (600, 175). In order to get the payoff $600 million for Audi Arabia, I multiplied 15 million barrels of oil (# of barrels) by $50 per barrel (price of barrel) subtracted by $10 per barrel (cost of production). In order to get the payoff $175 million for Irap, I multiplied 5 million barrels of oil (# of barrels) by $50 per barrel (price of barrel) subtracted by $15 per barrel (cost of production). The payoffs associated with the outcome (low, high) is (540, 275). In order to get the payoff $540 million for Audi Arabia, I multiplied 9 million barrels of oil (# of barrels) by $70 per barrel (price of barrel) subtracted by $10 per barrel (cost of production). In order to get the payoff $275 million for Irap, I multiplied 5 million barrels of oil (# of barrels) by $70 per barrel (price of barrel) subtracted by $15 per barrel (cost of production). I calculated the other payoffs the same way as I calculated the first two. The only difference was the cost of production and the price per barrel. The payoffs associated with the outcome (high, low) is (750, 135). Audi Arabia’s expected payoff is $750 million. Irap’s expected payoff is $135 million. The payoffs associated with the outcome (low, low) is (630, 195). Audi Arabia’s expected payoff is $630 million.  Irap’s expected payoff is $195 million.

One of the topics related to this question that has been ignored is what type of game it represents. I will be going into more detail on what game it represents in the reasonableness section of this short report.

**Analysis**

 At the highest combined production levels, the price per barrel is minimized. At the lowest combined production levels, the price per barrel is maximized. If you continue to increase production and put more oil on the market, then if there is too much of it, the price decreases.

Audi Arabia would prefer to produce at a high level while Irap produces at a low level. The low production level from Irap allows Audi Arabia to sell oil from high production levels at a higher price. Irap would prefer to produce at a high level while Audi Arabia produces at a low level. This allows Irap to sell their high production at a higher price.

 Analyzing the strategy matrix, production levels that result based on a choice of strategy, you’ll see that both Audi Arabia and Irap favor an outcome. Audi Arabia favors the outcome where they produce at a high level while Irap produces at a low level. The low production level from Irap allows Audi Arabia to sell oil from high production levels at a higher price. Irap favors the outcome where they produce at a high level, while Audi Arabia produces at a low level. This allows Irap to sell their high production at a higher price.

 Using the best response analysis technique, I found that there is only one pure strategy equilibrium outcome in this game. The equilibrium outcome is (high, high), (15, 5). The production at a low level is a dominated strategy for each country. This suggests that both countries should produce at a high level if they are acting independently. However, both countries are actually better off if they each agree to produce at a low level, keeping the price per barrel at $80.

 The payoff polygon below shows which outcomes are Pareto Optimal. The equilibrium outcome (high, high) and the outcome (low, low) are not pareto optimal, while the outcome (low, high) and the outcome (high, low) are pareto optimal. The outcomes (low, high) and (high, low) are pareto optimal because they both don’t stay inside the payoff polygon when traveling North East. The equilibrium outcome (high, high) and the outcome (low, low) are not pareto optimal because they both stay inside the payoff polygon when they travel North East.

(Low, Low)

**Pareto Optimal Outcomes**

**Equilibrium Outcome**

(High, Low)

(High, High)

(Low, High)

Not Pareto Optimal Pareto Optimal

**Reasonableness**

 Like I mentioned before in the representation section, production at a low level is a dominated strategy for each country. This leads to an assumption that both of the outcomes should produce at a high level if they are acting independently. Nonetheless, both countries are better off if they both agree to produce at a low level, which keeps the price per barrel at $80.

 This game is considered as the Prisoners Dilemma. They should each promise to produce at a low level because they both would be better off. If at any point one of the countries cheats, then the other one should cheat as well. In some ways it would be better to play tit-for-tat or a copycat strategy here. If this game were to be played every day, their goal would be to try to keep production levels low. At (high, high), the consumer benefits because the price is the lowest. Because of that, then Audi Arabia and Irap should not choose that outcome. They should negotiate and collaborate to choose the outcome (low, low).

**Summary/Conclusion**

 In conclusion, I suggest that both Audi Arabia and Irap should employ the tit-for-tat strategy or the copycat strategy. This is because if one country chooses to cheat, then the other country should cheat as well to protect themselves. If this strategy doesn’t work for them, then I suggest that both countries choose to keep their production levels low and keep their prices high.